

286 Signals of both kinds were displayed, of which 250 or 87.4 per cent, were fully justified. 56 cases of winds of 25 miles and over per hour, from scattered stations, were reported, for which signals had not been ordered. The above does not include signals ordered for 49 display stations, where the velocity is only estimated. Thirty-one signals were ordered late.

NAVIGATION.

Stage of Water in Rivers.—In the table on the right-hand side of chart No. III are given the highest and lowest stages of water, as recorded on the Signal Service river gauges, during November, 1880. During the entire month the rivers throughout the country continued remarkably low, no freshet worthy of special note being recorded. The *Missouri* remained almost stationary throughout the month, the largest monthly range at any individual station being 17 inches at Omaha; on the 18th it commenced to freeze at Yankton. In all the other rivers there was a general tendency to rise during the 1st, (ending Nov. 6th,) and 2nd, (ending Nov. 13th,) weeks, and, except at stations in the lower Mississippi, a general fall during the 3rd and 4th weeks.

Ice in Rivers and Harbors.—Below is a summary of the data in reference to the formation of ice upon navigable streams, canals and in the harbors at Lake ports. Ice commenced forming in large quantities in the rivers of the Northwest about the middle of the month and in those over the eastern portions of the country from the 19th to the 22nd. The early closing of the canals of Pennsylvania and New York entailed large losses upon those interested therein. The following items are arranged geographically: *Missouri river.*—Fort Bennett, Dak., 17th, river frozen over, navigation closed; 18th, people crossing on the ice. Omaha, Neb., 14th to 30th floating ice; 16th, ferry boats stopped running. Leavenworth, the river full of ice from the 17th to the end of the month. *Platte River.*—North Platte, Neb., 5th, ice 3 inches thick. Clear Creek, Neb., 16th, river closed; 19th, teams crossing on ice; 30th, heavily loaded wagons "still crossing." *Middle Loup River.*—Austin, Sherman co., Neb., 30th, teams crossing on ice. *Red River of the North.*—St. Vincent, Minn., 11th, river freezing; 12th, navigation closed. *Mississippi.*—St. Paul, Minnesota, 13th to 16th, floating ice; navigation closed on the 16th; 17th, river frozen over. La Crosse, Wis., 14th and 16th, floating ice; 19th, river frozen over. Dubuque, Ia., 16th, floating ice, navigation closed, earliest date on record; 22nd, frozen over, men crossing; 23rd, teams crossing. Fulton, Ill., and Clinton, Ia., 15th, navigation closed—same date as in 1872, but earlier than any other recorded date—at Clinton, ice in river on 17th, gorged on 18th and 13 inches thick on the 30th. Davenport, Ia., 21st, river frozen along banks; 22nd, gorged and closed on earliest date on record; 25th, frozen over; 26th, people crossing; 28th, teams crossing. Muscatine, Ia., 16th, floating ice; 21st, river closed by ice, "earliest closing on record;" 29th, first team crossed—ice in channel 7 inches thick. Burlington, Ia., 16th, floating ice quite dangerous to navigation, last boat passed down, navigation closed; 18th to 21st, floating ice; 22nd, gorged; 23rd, frozen over, people crossing; 30th, teams crossing. Montrose, Iowa, 21st, river frozen over. Keokuk, Iowa, 17th, first ice in river, Illinois side closed; 18th, navigation closed, heavy floating ice; 19th, canal frozen over; 22nd to 30th, heavy floating ice. St. Louis, Mo., 18th, navigation suspended; 18th to 30th, floating ice. *Des Moines River.*—Boonsboro, Ia., 15th, river frozen, men crossing; 18th, teams crossing. Des Moines, 16th, river frozen over. Keokuk, Ia., 20th, Des Moines river frozen over near the mouth. *Kansas River.*—Lawrence, Kan., 18th, frozen over. *Neosho or Grand River.*—Fort Gibson, Ind. Ter., 18th, frozen over; 19th, ice 3 inches thick. *Rock River.*—Frozen over at Lyndon, Ills., on the 14th and at Rockford, Ill., on the 17th. *Ohio River.*—Pittsburg, Pa., 18th, 19th and 23d, ice in river; 22d, frozen over. *Monongahela River.*—Morgantown, W. Va., 22nd to 28th, frozen over; 29th, opening; 29th, Cheat river opening; 30th, ice in Monongahela breaking up; at two a. m. ice gorged for a distance of four miles. *Susquehanna River.*—West Branch—Milton, Pa., 24th, frozen over; North Branch—Catawissa, 26th, closed by ice. *Delaware River.*—Philadelphia, 23rd, floating ice. *Hudson River.*—Albany, 21st and 22nd, floating ice; 23rd frozen over; 21st, ice formed on canal; 22nd, navigation on canal suspended; 25th, navigation entirely closed; 24th, closed from Albany to Hudson. In a report on the closing of the Hudson, at Newburgh, N. Y., based on observations recorded by Hutchings and Mr. James H. Gardiner, and giving details for the years 1740, 1755, 1764, 1770, 1779, 1785, 1789 to 1831, 1834 to 1838 and 1850 to 1878, only five November dates appear, which are as follows:—November 28th, 1796; November 20th, 1797; November 23rd, 1798; November 13th, 1820 and November 29th, 1823. In a table, published in Hough's *New York Meteorology, 2nd series*, giving the dates of closing of the Hudson at Albany, and based upon observations for the years 1645, 1646 and 1790 to 1872, the following November dates, prior to the 25th, are found:—13th, 1820; 23rd, 1798 and 24th, 1645. In another table in the same work, giving the closing at Hudson from 1817 to 1870, inclusive, the following November dates only appear:—25th, 1838 and 30th, 1820. *Connecticut River.*—Springfield, Mass., 22nd, frozen over. New Haven, 24th, navigation on river closed; river full of floating ice; earliest date of closing of navigation during the past 48 years. *Watuppa Lake.*—Mass., 27th, ice 4 inches thick. *Penobscot River.*—Bangor, Me., 24th, ice quite thick; 27th, navigation closed on the earliest date for the past 38 years. At this port, it has occurred but twice previously in November since 1544, namely, on November 30th, 1871, and November 29th, 1875. *Kennebec River.*—Gardiner, Me., 23rd, river closed. From a record of the closing of this river for the past 94 years, it appears that earlier dates have only been recorded on 8 years, as follows: November 16th, in 1820 and

1823; 18th, in 1786; 19th, in 1804 and 1873; 20th, in 1806, and 22nd 1797 and 1875; in 6 previous years—1792, 1798, 1809, 1825, 1835 and 1855, it has closed on the same date, the 23rd. *Lake Superior*.—Duluth, 15th, ice forming rapidly; 24th, ice broken up by storm; 25th, commenced to go out and lodge along north shore; 28th end of lake full of ice; 29th, lake filled with thin ice as far as can be seen. Ashland, Wis., Long Island Bay closed by ice on the 16th. Marquette, Mich., 13th, navigation closed. *Geneva Lake*.—Bloomfield, Wis., 23rd, frozen over. *Wolf River*.—Near Embarrass, Wis., 23d, frozen over. *Lake Michigan*.—Escanaba, 25th, bay frozen over; 29th, navigation practically closed. The sudden and unexpected closing of navigation laid up 21 vessels at this port, 12 of which were loaded. Chicago, 21st, lake frozen; 26th, many vessels reported ice-bound at different ports along the lake; 30th, navigation generally closed. *Grand River*.—Lausing, Mich., 19th, closed by ice. Grand Haven, Mich., 21st, river closed by ice. *Lake Huron*.—Alpena, Mich., 22nd, Thunder Bay river frozen over; Thunder Bay full of ice as far as can be seen; 12 or 15 boats frozen in; 24th, steamer arrived from Detroit with great difficulty; 28th, bay partly clear. Port Huron, Mich., 20th, Black river frozen over solid, "the harbor crowded with vessels waiting an opportunity to break through St. Clair Flats which are reported frozen over"; 23rd, vessels going into winter quarters. *Detroit River*.—Detroit, 19th to 21st, ice in river; 22nd, navigation suspended; 26th, navigation resumed. *Lake Erie*.—Toledo, 17th, ice in river; 28th, frozen over, ice 2 inches thick; 22nd, 6 inches thick; 24th, navigation closed. Sandusky, Ohio, 19th, ice 2 inches thick formed over greater part of bay; steamers going into winter quarters; 20th, bay frozen entirely across; 27th, twenty-four large propellers, grain-laden, ice bound near Point au Pelee island. Erie, Pa., 22nd, bay frozen over. *Lake Ontario*.—Oswego, N. Y., 22nd, canal closed by ice. *Schroon Lake*, N. Y., 28th, frozen over. *Lake Champlain*.—Burlington, Vt., 24th, Winooski river and upper part of lake frozen over.

CANALS.—*Miami*.—Cincinnati, Ohio, 19th, closed; 22nd, frozen over; 27th, ice 5 inches thick. *Erie*.—Rochester, N. Y., 19th, canal and Genessee river frozen over; 22nd, navigation in canal closed—700 boats frozen in between Buffalo and Syracuse. *Pennsylvania*—*West branch*—Milton, Pa., 22nd, frozen over; *North branch*—Catawissa, Pa., 22nd, closed by ice. *Lehigh, Delaware and Morris*—Easton, Pa., 24th, frozen up—navigation entirely ceased—100 boats frozen up at Port Delaware; the Lehigh canal, from Easton to Mauch Chunk, lined with loaded canal boats fast in the ice—"such a cold spell at this season has not been known for a great many years." Dyberry, Pa., 22nd, canal navigation closed. *Delaware and Hudson River*.—Port Jervis, N. Y., 1st, navigation resumed after having been closed for want of water since September 22nd.

TEMPERATURE OF WATER.

The temperature of water, as observed in rivers and harbors at Signal Service Stations, with the average depth at which observations were taken, is given in the table on the left hand side of chart No. II. Owing to the breaking of the thermometer, ice etc., observations are wanting, as follows: Alpena, from the 17th; Augusta, 11th to 15th; Chicago, from the 21st; Duluth, from the 28th; Detroit, from the 19th; Escanaba, from the 25th; Grand Haven, from the 21st; Marquette, 22nd, 29th and 30th; Mobile, from 1st to 23rd inclusive; Norfolk, from the 26th; Sandusky from the 21st; Toledo, from the 13th.

ATMOSPHERIC ELECTRICITY.

Thunder Storms have been comparatively rare, except in the Gulf States. Storms were reported from more than one station in that district on the 4th, 5th, 8th to 10th, 12th, 16th, 19th and 30th.

Zodiacal Light.—*Indiana*: New Corydon, 1st-3rd, 7th-9th, 12th, 14th, 15th, 21st-23rd, 25th-27th, 29th, 30th. *Iowa*: Monticello, 8th, 22nd, 29th. *Kansas*: Yates Centre, 21st, 22nd, 26th, 30th. Lawrence, looked for, none seen. *Minnesota*: St. Vincent, 14th and 30th. *Massachusetts*: Cambridge, (Harvard University,) 22nd, 23rd, 27th, 29th, 30th; Somerset, 29th. *Ohio*: Bellefontaine, 20th, 22nd, 23rd. *Missouri*: Oregon, 4th, 20th-22nd, 28th, 29th. *Nebraska*: Clear Creek, 26th, 28th.

Auroras.—On the 1st, the aurora was visible in Maine, Vermont and at Bismarck, Dak. On the 2nd and 3rd, it was observed generally in New England, New York and New Jersey. The most southerly station reporting it on the former date, was Somerville, N. J., and on the latter date, Moorestown, N. J. It was also observed, on the 2nd, at St. Vincent, Minn., and on the 3d, at Dayton, Wash. Ter. On the 21st, a display was observed at Newport, R. I., Wellsboro', Pa., and Lansing, Mich. On the 30th, a display was general in the northern part of New England; the most southerly station reporting, was Somerset, Mass.; it was noted the same day at Oswego, Port Huron and Breckenridge. Isolated displays are reported from New England under dates of the 4th, 6th to 10th, inclusive, from Pennsylvania on the 23rd and 26th, from Iowa on the 14th, 25th and 29th, Dakota on the 9th, from Minnesota on the 20th, 23rd, 27th and 29th, and from Nebraska on the 28th, from Indiana on the 20th, from Michigan on the 22nd. Lack of space forbids a description of these auroras, none of which appear from their descriptions, to have been unusually bright.

OPTICAL PHENOMENA

Solar Halos.—Guttenburg, Ia., 25th, 10 a. m., to 1 p. m., brilliant halo with five mock suns, two green and yellow and three white. Clinton, Ia., 17th, double halo in afternoon.

Lunar Halos.—Clinton, Ia., 17th, large double halo with two mock moons.